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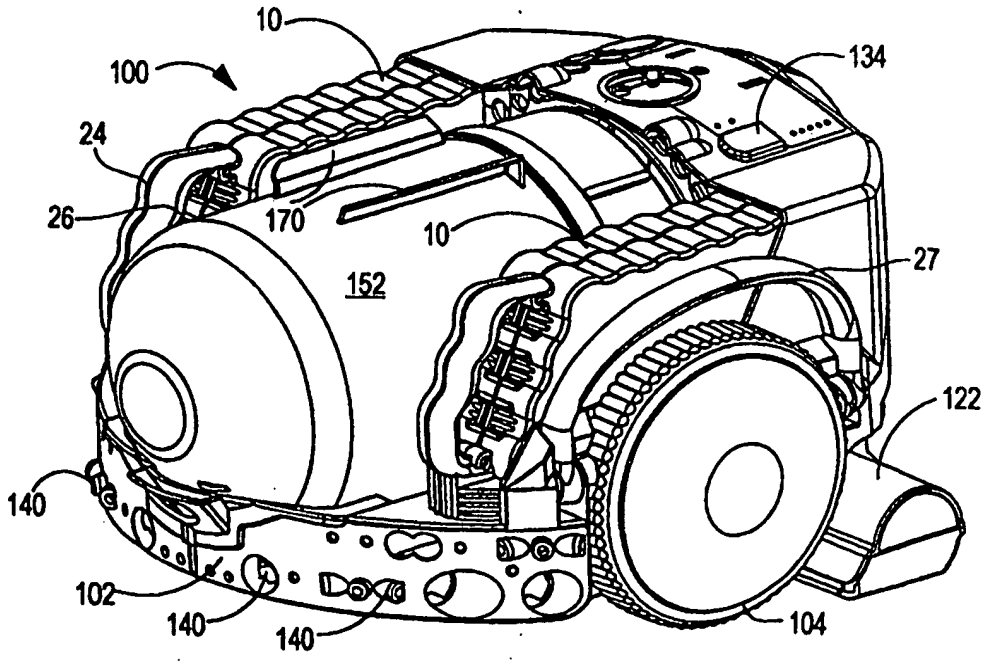

(57) Abstract

An electrical appliance (100) has battery packs (10) which are supported on a chassis (102) of the appliance (100) in a visible position. Each pack (10) has a handle (24) which a user can grasp to withdraw the pack (10) from the chassis (102). The handle has a lever (26) which a user can squeeze to operate a securing mechanism to release the pack (10) from the chassis (102). Should a user attempt to lift

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An Electrical Appliance with Battery Packs

The invention relates to an electrical appliance, particularly to an electrical appliance which is powered by means of at least one on-board battery pack. The electrical appliance can be an autonomous or robotic vacuum cleaner.

Electrical appliances powered by on-board battery packs have been known for many years. The majority of such appliances are those which require to be portable or manoeuvrable during their operation; for example, power tools, domestic appliances and autonomous vehicles. Autonomous or robotic vacuum cleaners are suitable for being powered by means of on-board battery packs.

Examples of robotic vacuum cleaners having on-board battery packs are shown in EP 0 635 236 A1, US 5,787,545 and US 5,109,566. In each of these examples, the batteries are located within the cleaner housing.

The present invention seeks to provide an electrical appliance which is more convenient to use.

An aspect of the invention provides an electrical appliance comprising a chassis supporting an on-board power supply and means, powered by the power supply, for allowing the appliance to travel across a surface, wherein the power supply comprises a battery pack which is releasable from the chassis and which is supported on the chassis such that, in use, the pack is visible to a user.

By providing a battery pack which is releasable from the chassis of the appliance, a user can simply remove the pack when it needs replacing or recharging. By mounting the battery pack in a visible position, a user can easily find the pack without the need to remove part of the housing of the appliance or to turn the appliance on to its side to access the battery. There is a further advantage that the cleaner is not unduly disturbed during a battery changing operation. This is particularly important with an autonomous

appliance that navigates around an area, since moving the appliance during a battery change could cause the appliance to become confused when it is restarted.

Preferably the battery pack has a handle by which a user can grasp the pack to remove it from the chassis of the appliance.

A problem with providing a handle on the battery pack is that a user may try to lift the appliance by the handle on the pack. The appliance is heavy and the securing mechanism for the battery pack is inadequate to support the full weight of the appliance. Therefore, the securing mechanism for the battery pack is operable by a release member which forms part of the handle and, more preferably, the release member is located on the handle so that a user, in grasping the handle to attempt to lift the appliance, will operate the release member and thereby release the battery pack from the appliance, thus preventing any damage to the user or appliance which may result if the user was successful in lifting the appliance by the battery pack handle.

Preferably at least two battery packs are provided, one battery pack being located on each side of a component of the appliance, such as a cyclonic separator. This allows more flexibility in the design of the appliance.

Preferably, the battery packs are arranged symmetrically about the centre of gravity of the appliance. This enhances the manoeuvrability of the appliance when the appliance is designed so that it turns about its centre of gravity. Preferably, the battery packs are arranged along a lateral axis of the appliance, the lateral axis lying along a diameter thereof at the opposing ends of which are a pair of driven wheels. The stability of the appliance and its balance is enhanced by such an arrangement.

It is preferred if the appliance is a vacuum cleaner, more particularly a vacuum cleaner which is autonomous. The vacuum cleaner is more preferably one which carries cyclonic separating apparatus for separating dirt and dust from an airflow.

An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, wherein:

Figure 1 is a perspective view of a battery pack according to the invention;

Figures 2a and 2b are plan views of first and second parts of the battery pack of Figure 1;

Figure 3 is a perspective view of a vacuum cleaner carrying and powered by battery packs as shown in Figures 1 and 2;

Figures 4, 5 and 6 are plan, rear and side views respectively of the vacuum cleaner of Figure 3;

Figure 7 is a sectional detail showing the connection between one of the battery packs of Figure 1 and the vacuum cleaner of Figures 3 to 6; and

Figure 8 is a schematic side view of a battery charger in combination with the battery pack of Figure 1.

A battery pack 10 according to the invention is illustrated in Figures 1 and 2. The battery pack 10 has a housing 12 which is made up of two half shells 14a, 14b made from a plastics material such as Nylon or ABS. The half shells 14a, 14b are essentially symmetrical and together define an enclosure 16 in which a plurality of cells 18 are located. The cells 18 are connected in two groups 18a, 18b as illustrated in Figure 2a, with a flexible connection 19 being provided between cells 18b' and 18b". The cells 18 are spaced apart and maintained in their fixed positions by spacer walls 20 which are formed of insulating material and specifically adapted to conform to and follow the contours of the side walls of the cells 18 in order to hold them securely in position. The spacer walls 20 are preferably moulded integrally with the half shells 18a, 18b and are therefore formed from the same material as the half shells 18a, 18b. In the illustrated embodiment, thirty cells 18 are provided in the housing in two groups of fifteen cells. The cells are preferably nickel-cadmium sub-C cells with a rating of 2.0 ampere-hours or greater, or nickel metal hydride (Ni MH) cells having a rating of 3.0 ampere-hours or greater. The half shells 18a, 18b are joined together by way of screws or non-releasable fasteners 22a, 22b located in the half shells 18a, 18b.

The housing 12 has a front end 12a which carries a handle 24 by means of which the battery pack 10 can be carried. The handle 24 is profiled so as to conform to the shape of a user's hand for comfort and grip. The interior of the handle 24, ie on the side of the handle 24 facing the body of the housing 12, comprises a lever portion 26 (see Figure 2a) which is also profiled to conform to the contours of a user's hand. The lever portion 26 is moulded from a plastics material and is pivotably connected to the housing 12 at the base of the handle 24 by way of a pivot connection 28. The lever portion 26 is biased into the position shown in Figure 2a by a spring 30. The lever portion 30 also carries a downwardly projecting tooth 32 located on an arm of the lever portion which projects generally horizontally away from the pivot connection 28. The tooth 32 projects downwardly through an aperture 34 in the lower surface of the housing as illustrated in Figure 2b. The fixed portion 24a of the handle 24 is recessed so that the lever portion 26 can pivot about the pivot connection 28 with respect to the fixed portion 24a and against the biasing action of the spring 30. This action results in the tooth 32 being lifted sufficiently that the tooth no longer projects through the aperture 34.

The housing 12 incorporates at least one electrical connection 36 which is in electrical communication with the cells 18 in whichever configuration is appropriate for the appliance to be powered by the battery pack 10. The electrical connection 36 is located at the end of the housing 12 remote from the handle 24 and is preferably surrounded by a collar or is otherwise recessed for safety reasons.

The housing 12 also has an inlet port 38 which is capable of receiving cooling fluid and passing it directly to the enclosure 16. The inlet port 38 therefore essentially comprises an opening leading directly from the exterior of the housing 12 to the interior thereof. the inlet port is located, like the electrical connector, at the end of the housing 12 remote from the handle 24. The opening is covered, at least in part, by protective fins 38a which are present partly to prevent any foreign bodies from entering the housing, partly to strengthen the housing, and partly to diffuse the incoming cooling fluid. At least one outlet 40 is provided at the end of the housing 12 opposite the end at which the inlet port

38 is located. In the illustrated embodiment, there are four outlet ports provided 40a, 40b, 40c and 40d, each of which are covered, at least in part, by protective fins 40e. The outlet ports 40 are spaced over the end 12a of the housing 12 so that there is an outlet port 40a, 40d adjacent the most remotely spaced cells 18 at the end of the enclosure 16 closest to the handle 24.

A temperature sensor 42 is located in the enclosure adjacent one of the outlet ports 40. The sensor 42 can be mounted in the enclosure between two cells 18 as shown in bold lines in Figure 2b, or else it can be mounted directly on one of the cells 18 as shown in dotted lines in the same Figure. The sensor 42 is connected to an indicator located at a convenient position on the housing 12 to give an indication to the user if the temperature inside the housing 12 becomes dangerously high. Alternatively, the sensor can be connected directly to electrical appliance which is powered by the battery pack 10 via the connection 36 to operate a switch which will deactivate the appliance if the battery pack becomes too hot.

Located on the lower surface of the housing 12 at the end 12a thereof adjacent the handle 24, are two opposing lugs 44 projecting outwardly from the housing 12. The lugs extend in a horizontal plane as can be seen from Figure 7, to which further reference will be made below. The purpose of the lugs 44 will be explained later with reference to Figure 7.

The battery pack 10 described above can be used to power a robotic vacuum cleaner as illustrated in Figures 3 to 6. The term "robotic" is here used to mean that the vacuum cleaner is capable of operating so that it navigates its own way around a room to be cleaner without human intervention and without bumping into, or becoming lodged against, obstacles located around the room. An overview of such a machine is given below.

The vacuum cleaner 100 shown in the drawings has a supporting chassis 102 which is generally circular in shape and is supported on two driven wheels 104 and a castor

wheel 106. The chassis 102 is preferably manufactured from high-strength moulded plastics material, such as ABS, but can equally be made from metal such as aluminium or steel. The chassis 102 provides support for the components of the cleaner 100 which will be described below. The driven wheels 104 are arranged at either end of a diameter of the chassis 102, the diameter lying perpendicular to the longitudinal axis of the cleaner 100. Each driven wheel 104 is moulded from a high-strength plastics material and carries a comparatively soft, ridged band around its circumference to enhance the grip of the wheel 104 when the cleaner 100 is traversing a smooth floor. The soft, ridged band also enhances the ability of the wheels 104 to mount and climb over small obstacles. The driven wheels 104 are mounted independently of one another via support bearings (not shown) and each driven wheel 104 is connected directly to a motor which is capable of driving the respective wheel 104 in either a forward direction or a reverse direction. By driving both wheels 104 forward at the same speed, the cleaner 100 can be driven in a forward direction. By driving both wheels 104 in a reverse direction at the same speed, the cleaner 100 can be driven in a backward direction. By driving the wheels 104 in opposite directions, the cleaner 100 can be made to rotate about its own central axis so as to effect a turning manoeuvre. The aforementioned method of driving a vehicle is well known and will not therefore be described any further here.

The castor wheel 106 is significantly smaller in diameter than the driven wheels 104 as can be seen from, for example, Figure 6. The castor wheel 106 is not driven and merely serves to support the chassis 102 at the rear of the cleaner 100. The location of the castor wheel 106 at the trailing edge of the chassis 102, and the fact that the castor wheel 106 is swivellingly mounted on the chassis by means of a swivel joint 110, allows the castor wheel 106 to trail behind the cleaner 100 in a manner which does not hinder the manoeuvrability of the cleaner 100 whilst it is being driven by way of the driven wheels 104. The swivel joint 110 is most clearly shown in Figure 6. This type of arrangement is well known. The castor wheel 106 can be made from a moulded plastics material or can be formed from another synthetic material such as Nylon.

Mounted on the underside of the chassis 102 is a cleaner head 122 which includes a suction opening 124 facing the surface on which the cleaner 100 is supported. The suction opening 124 is essentially rectangular and extends across the majority of the width of the cleaner head 122. A brush bar (not shown) is rotatably mounted in the suction opening 124 and a motor 128 is mounted on the cleaner head 122 for driving the brush bar by way of a drive belt (not shown) extending between a shaft of the motor 128 and the brush bar. The cleaner head 122 is mounted on the chassis 102 in such a way that the cleaner head 122 is able to float on the surface to be cleaned. This is achieved in this embodiment in that the cleaner head 122 is pivotally connected to an arm (not shown) which in turn is pivotally connected to the underside of the chassis 102. The double articulation of the connection between the cleaner head 122 and the chassis 102 allows the cleaner head to move freely in a vertical direction with respect to the chassis 102. This enables the cleaner head to climb over small obstacles such as books, magazines, rug edges, etc. Obstacles of up to approximately 25mm in height can be traversed in this way. A flexible or telescopic conduit is located between a rear portion of the cleaner head 122 and an inlet port located in the chassis 102.

In order to assist the cleaner head 122 to move vertically upwards when an obstacle is encountered, forwardly projecting ramps 136 are provided at the front edge of the cleaner head 122. In the event that an obstacle is encountered, the obstacle will initially abut against the ramps 136 and the inclination of the ramps will then lift the cleaner head 122 over the obstacle in question so as to avoid the cleaner 100 from becoming lodged against the obstacle. The cleaner head 122 is shown in a lowered position in Figure 6. The castor wheel 106 also includes a ramped portion 117 which provides additional assistance when the cleaner 100 encounters an obstacle and is required to climb over it. In this way, the castor wheel 106 will not become lodged against the obstacle after the cleaner head 122 has climbed over it.

As can be seen from Figures 3 and 4, the cleaner head 122 is asymmetrically mounted on the chassis 102 so that one side of the cleaner head 122 protrudes beyond the general

circumference of the chassis 102. This allows the cleaner 100 to clean up to the edge of a room on the side of the cleaner 100 on which the cleaner head 122 protrudes.

The chassis 102 carries a plurality of sensors 140 which are designed and arranged to detect obstacles in the path of the cleaner 100 and its proximity to, for example, a wall or other boundary such as a piece of furniture. The sensors 140 comprise several ultra-sonic sensors and several infra-red sensors. The array illustrated in Figures 3 and 5 is not intended to be limitative and the arrangement of the sensors does not form part of the present invention. Suffice it to say that the vacuum cleaner 100 carries sufficient sensors and detectors 140 to enable the cleaner 100 to guide itself or to be guided around a predefined area so that the said area can be cleaned. Control software, comprising navigation controls and steering devices, is housed within a housing 142 located beneath a control panel 144 or elsewhere within the cleaner 100.

The vacuum cleaner 100 also includes a motor and fan unit supported on the chassis 102 for drawing dirty air into the vacuum cleaner 100 via the suction opening 124 in the cleaner head 122. The chassis 102 also carries a cyclonic separator 152 for separating dirt and dust from the air drawn into the cleaner 100. The inlet port which communicates with the rear portion of the cleaner head 122 via the conduit mentioned above forms the inlet to the cyclonic separator 152. The cyclonic separator, which preferably comprises two cyclones in series, need not be described any further here, being known technology and described adequately elsewhere.

The cyclonic separator 152 is releasable from the chassis 102 in order to allow emptying of the cyclonic separator 152. A hooked catch (not shown) is provided by means of which the cyclonic separator 152 is held in position when the cleaner 100 is in use. When the hooked catch is released (by manual pressing of a button 134 located in the control panel 44), the cyclonic separator 152 can be lifted away from the chassis 102 by means of gripper portions 170. The cyclonic separator 152 can then be emptied.

Two battery packs 10 as described above are located on the chassis 102 on either side of the cyclonic separator 152. The battery packs 10 are identical and are spaced from the central axis of the vacuum cleaner 100 by a significant distance, say between 50 and 150 mm. In the embodiment illustrated, the battery packs are spaced from the central axis of the vacuum cleaner by a distance of about 87mm. The provision of two separate battery packs 10 allows the weight thereof to be evenly distributed without requiring the battery pack to be located directly over the centre of the cleaner 100. This gives much greater flexibility of design and allows the dirt and dust collecting means of the cleaner 100 (in this case the cyclonic separator 152) to occupy the most central position. This can be beneficial for the user. Furthermore, the battery packs 10 are located so that the centre of gravity of each individual battery pack 10 is located over the axis which joins the centres of the driven wheels 104. This axis lies along a diameter of the generally circular chassis 102. This arrangement gives the cleaner 100 better balance than would otherwise be the case. It will be appreciated that the position of the centre of gravity of the cleaner 100 will be affected to a considerable extent by the motor as well as the battery packs 10, all of which contribute significantly to the weight of the cleaner 100.

The battery packs 10 are held in position on the chassis 102 so that the battery packs are not permitted to move during normal use of the vacuum cleaner 100. The end of each battery pack 10 remote from the handle 24 is received in a recess 180 formed in the structure of the vacuum cleaner 10 (see Figure 6). The recess 180 is formed in the moulding 142 which forms a housing for the motor and fan unit, which housing 142 is fixedly attached to the chassis 102. The end of the battery pack housing 12 remote from the handle 24 is thus held securely on the chassis 102. Located in the recess 180 is a connector point 181 for forming an electrical connection with the battery pack 10. The electrical connector point 181 is positioned so that it is aligned with the electrical connection 36 on the battery pack 10 and projects into the recess 180 so that the connector point 181 and the connection 36 are automatically brought into electrical contact when the battery pack 10 is inserted fully into the recess 180. Also formed in the housing 142 of the motor and fan unit is a duct 186 which carries air exiting the fan

from the fan to an opening in the housing 142 which is located directly adjacent the inlet port 38 of the battery pack 10 when it is mounted on the chassis 102.

The chassis 102 also includes a pair of undercut grooves or channels 182 located in the portion of the chassis 102 adjacent the handle 24 of the battery pack 10. The grooves or channels 182 are open at the ends thereof facing the handles 24 of the battery packs 10 and are spaced apart by a distance which is slightly less than the spacing of the lugs 44. An aperture 184 corresponding to the cross-sectional area of the tooth 34 is positioned in the chassis 102 between the two grooves or channels 182. The location of the aperture 184 is such that it is aligned with the aperture 34 when the battery pack 10 is fully inserted in the recess 180. The arrangement is illustrated in Figure 7.

In the Figure, a section through the battery pack 10 is illustrated showing the lower surface of the housing 12 with the aperture 34 therein. The tooth 32 is also shown in its normal position of projecting through the aperture 34. In this position, the tooth 34 also projects through the aperture 184 in the chassis 102 and thereby prevents relative movement between the chassis 102 and the battery pack 10 in the direction of the channels or grooves 182. The lugs 44 extend outwardly from the lower surface of the housing 12 and are received in the grooves or channels 182 so that movement in other directions is prevented and the opposite end of the battery pack 10 is held securely in the recess 180. The battery pack 10 is thereby held securely in position on the chassis 102.

In order to release the battery pack 10 from the chassis 102, for example when recharging is required, the handle 24 of the battery pack is grasped by the user. The grasping motion squeezes the lever portion 26 of the handle towards the fixed portion about the pivot connection 28 so that the tooth 34 is raised and is released from the apertures 184, 34. The battery pack 10 is then able to move in a sliding manner so that the lugs 44 slide along the grooves or channels 182 until they are released therefrom. The battery pack 10 can then be lifted so that the end opposite the handle 24 emerges from the recess 180 and the battery pack 10 can be removed. The battery pack 10 is

returned to the chassis 102 in an identical manner, but in reverse: the end of the battery pack 10 is aligned with the recess 180 so that it can be slid thereinto in a direction along the grooves or channels 182. The sliding motion causes the lugs 44 to be received into the channels 182 and, as the battery pack 10 becomes fully received into the recess 180, the tooth 34 drops through the aperture 184 under the action of the spring 30 to hold the battery pack 10 in position and the electrical connection is automatically made between the cleaner 100 and the battery pack 10. The inlet port 38 is also automatically aligned with the opening of the duct 186. The connector point 181 is connected, within the cleaner 10, to the motor and fan unit, to the brush bar motor 28, to the motors for the driven wheels 104, and to the sensors 140 and control software so that all powered components of the cleaner 10 are able to take their power from the battery pack 10.

The vacuum cleaner 100 described above operates in the following manner. In order for the cleaner 100 to traverse the area to be cleaned, the wheels 104 are driven by the motors which, in turn, are powered by the batteries 10. The direction of movement of the cleaner 100 is determined by the control software which communicates with the sensors 140 which are designed to detect any obstacles in the path of the cleaner 100 so as to navigate the cleaner 100 around the area to be cleaned. Methodologies and control systems for navigating a robotic vacuum cleaner around a room or other area are well documented elsewhere and do not form part of the inventive concept of this invention. Any of the known methodologies or systems could be implemented here to provide a suitable navigation system. The battery packs 10 also power the motor and fan unit which draws air into the cleaner 100 via the cleaner head 122 and passes it to the cyclonic separator 152 where the dirt and dust is separated from the airflow. The battery packs 10 are also used to power the motor 28 which drives the brush bar which, in turn assists with pick-up, particularly on carpets.

The air which exits the cyclonic separator 152 is passed across the motor and fan unit by appropriate ducting, as is common in many appliances, including vacuum cleaners. However, in accordance with this invention, the air which then leaves the motor and fan unit is conducted along the duct 186 to the opening adjacent the inlet port 38 of the

battery pack 10. The air is then forced to enter the battery pack housing 12 via the inlet port 38 and pass into the enclosure 16. The air passes around and across the cells 18 in order to achieve a cooling effect before exiting the battery pack via the outlet ports 40. The spacing of the outlet ports 40a, 40b, 40c, 40d across the end 12a of the housing 12 ensures that the cooling air is spread throughout the enclosure 16 and is discouraged from following a restricted path which might result in some cells 18 being cooled less effectively than others. The air is expelled to the atmosphere from the outlet ports 40.

The battery packs 10 are removed from the cleaning device 100 for charging and inserted into a charging apparatus. Apparatus for recharging a battery pack 10 is illustrated in Figure 8. The apparatus comprises a recharger 200 having an appropriate mains supply connection 202 and a recess 204 for receiving the battery pack 10. Electrical connectors are provided in the recess 204 for supplying power to the battery pack for recharging purposes. Also provided in the recharger 200 is a fan 206, which is mains operated, for drawing air into the recharger 200 from the atmosphere via a first duct 208. A second duct 210 carries the air drawn into the recharger by the fan 206 from the fan 206 to the recess 204. The second duct 210 opens into the recess 204 immediately adjacent the inlet port 38 of the battery pack 10 when the battery pack 10 is located in the recess 204. Thus, when the battery pack 10 is inserted into the recess 204 for charging purposes, the fan draws air into the recharger 200 and passes it through the second duct 210 and into the housing 12 of the battery pack 10 in order to cool the cells during the recharging process. The cooling air is then expelled to the atmosphere via the outlet ports 40, in the same way as it is expelled during operation of the vacuum cleaner 100.

It will be appreciated that the recharger 200 can have a number of features which will assist the recharger 200 to operate with minimum user intervention. Features such as switches, located in the recess 204, which will automatically commence the recharging operation and/or bring the fan 206 into operation can be incorporated if desired.

battery pack 10. The air is then forced to enter the battery pack housing 12 via the inlet port 38 and pass into the enclosure 16. The air passes around and across the cells 18 in order to achieve a cooling effect before exiting the battery pack via the outlet ports 40. The spacing of the outlet ports 40a, 40b, 40c, 40d across the end 12a of the housing 12 ensures that the cooling air is spread throughout the enclosure 16 and is discouraged from following a restricted path which might result in some cells 18 being cooled less effectively than others. The air is expelled to the atmosphere from the outlet ports 40.

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It will be appreciated that the recharger 200 can have a number of features which will assist the recharger 200 to operate with minimum user intervention. Features such as switches, located in the recess 204, which will automatically commence the recharging operation and/or bring the fan 206 into operation can be incorporated if desired.

The invention is not intended to be limited to the precise details of the embodiment illustrated above. The use of battery packs is widespread and it is envisaged that more than two battery packs can be provided on the appliance, distributed about the chassis, if desired.

Claims

1. An electrical appliance comprising a chassis supporting an on-board power supply and means, powered by the power supply, for allowing the appliance to travel across a surface, wherein the power supply comprises a battery pack which is releasable from the chassis and which is supported on the chassis such that, in use, the pack is visible to a user.

2. An appliance according to Claim 1 wherein the battery pack comprises a housing having a handle by which a user can grasp the pack.

3. An appliance according to Claim 2 wherein the battery pack comprises a securing mechanism for securing the pack to the chassis of the appliance, the securing mechanism being operable by a release member which forms part of the handle.

4. An appliance according to Claim 3 wherein the release member is arranged so that it can be operated by squeezing the handle.

5. An appliance according to Claim 4 wherein the handle forms a loop having an open inner area through which a user can insert their hand and the release member is located on an inner side of the loop where a user grasps the handle.

6. An appliance according to any one of Claims 2 to 5 wherein the handle has a shape which is contoured to fit a user's hand and the release member has a complementary shape.

7. An appliance according to any one of the preceding claims wherein the securing mechanism comprises a tooth and the release member is a lever which is pivotally mounted with respect to the handle such that movement of the lever moves the tooth.

8. An appliance according to any one of the preceding claims comprising a component mounted centrally on the chassis and wherein the power supply comprises two battery packs which are located on opposite sides of the component.

9. An appliance according to Claim 8, wherein the component of the appliance comprises cyclonic separating apparatus for separating dirt and dust from an airflow.

10. An appliance according to Claim 8 or 9 wherein the battery packs are arranged symmetrically about a rotational centre of the appliance.

11. An appliance according to any one of Claims 8 to 10 wherein the means for allowing the appliance to travel across a surface comprise wheels or rollers which are arranged at opposing ends of a lateral axis of the appliance, the battery packs being located along the lateral axis.

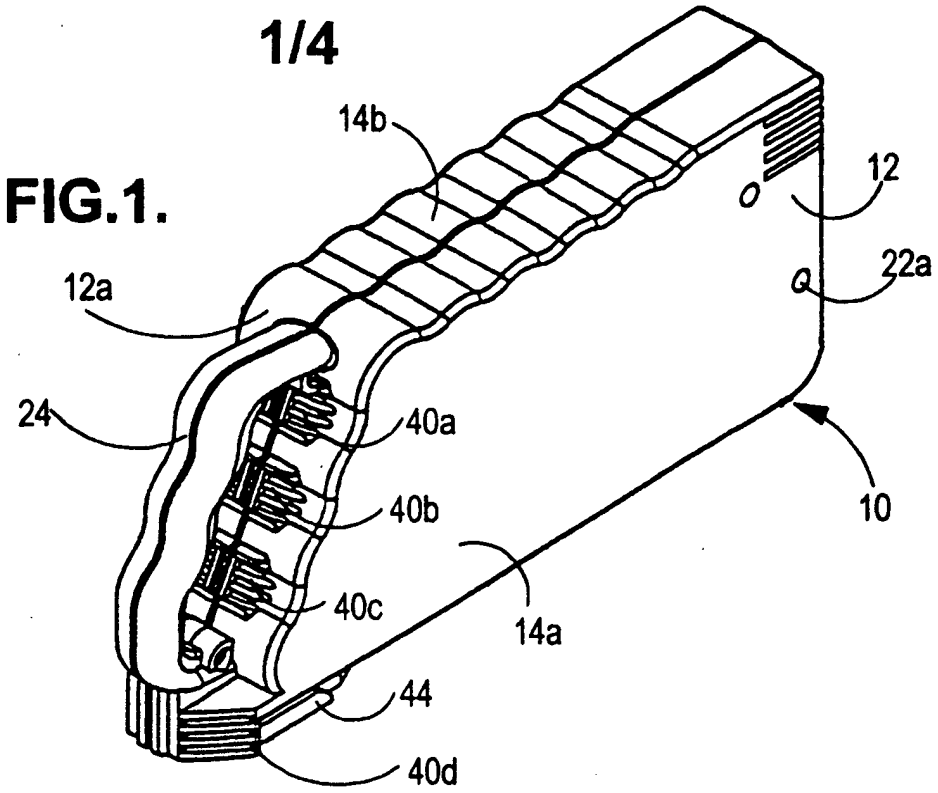
12. An appliance according to any one of the preceding claims, wherein the battery packs are rechargeable.

13. An appliance according to any one of the preceding claims, wherein the appliance is a vacuum cleaner.

14. An appliance according to anyone of the preceding claims wherein the appliance is autonomous.

15. A battery pack for use as a power supply on an electrical appliance according to Claim 1, the battery pack comprising a housing having a handle by which a user can grasp the pack and a securing mechanism for securing the pack to the chassis of the appliance, the securing mechanism being operable by a release member which forms part of the handle.

FIG.1.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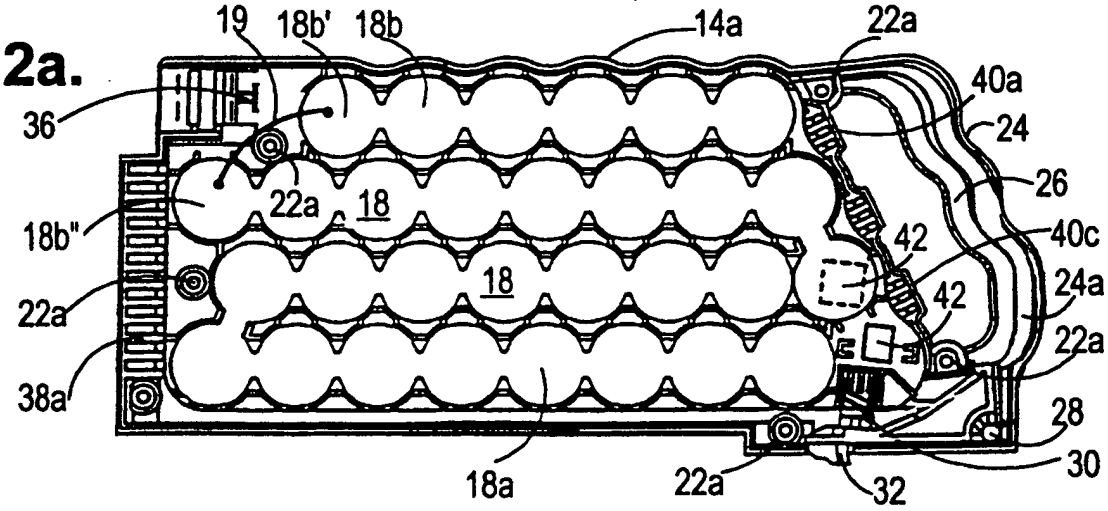
40d

FIG.2a.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18b
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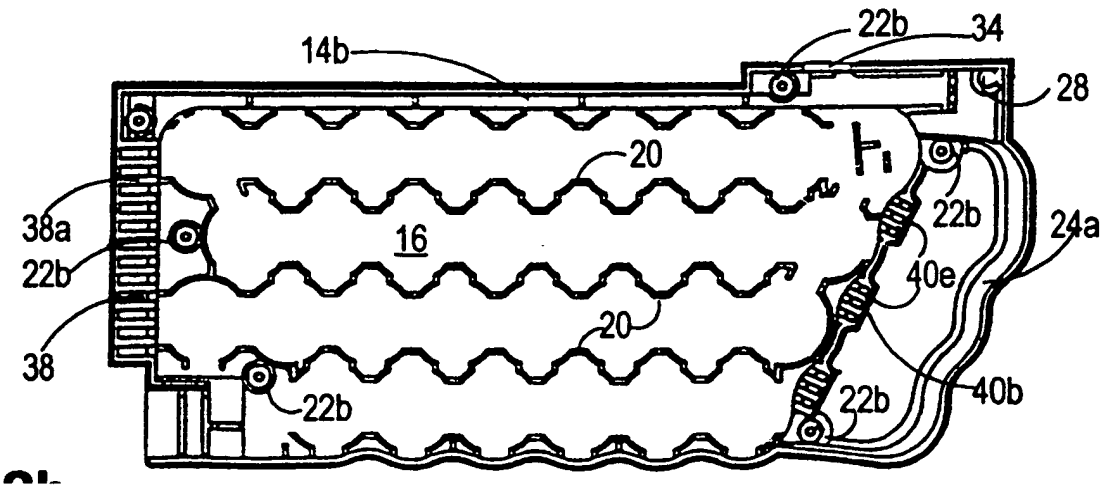
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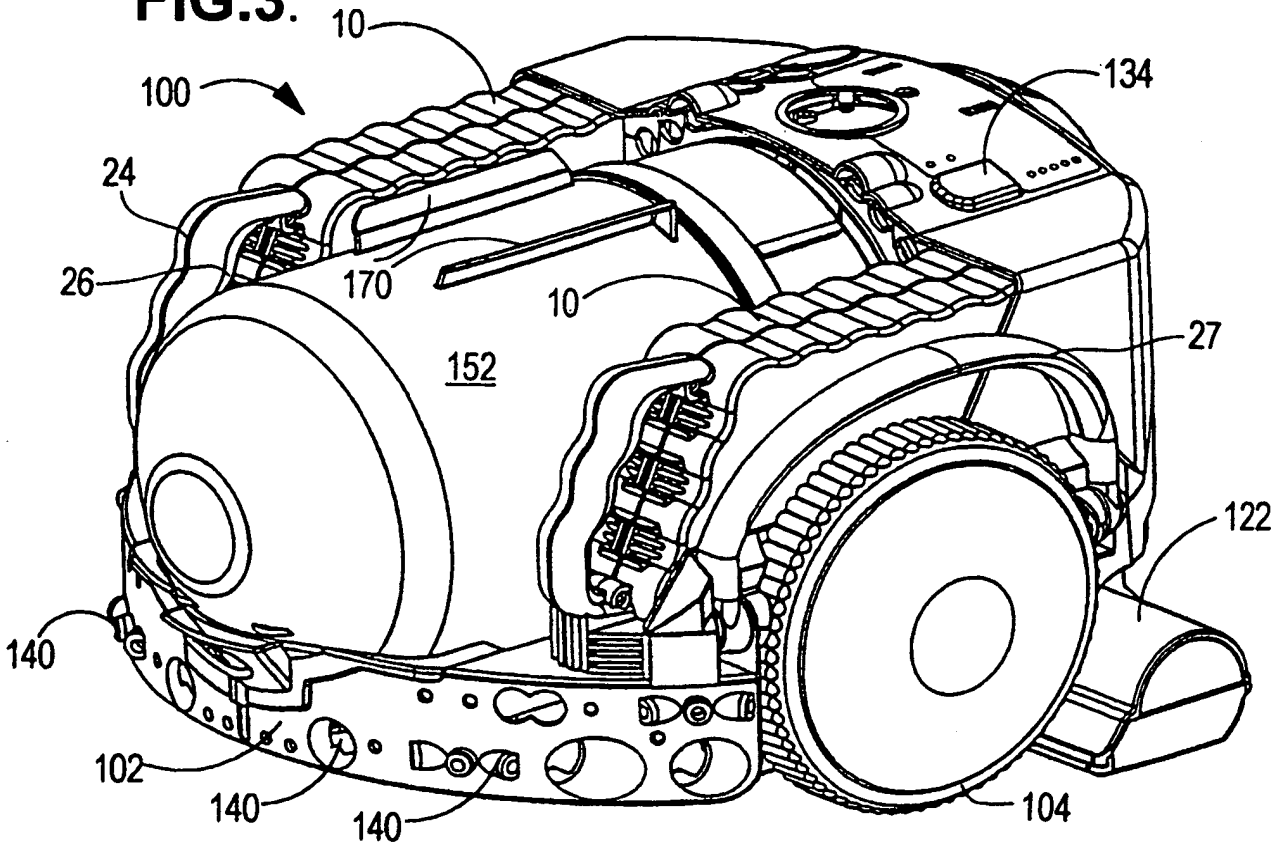
40b
22b
22b

FIG.3.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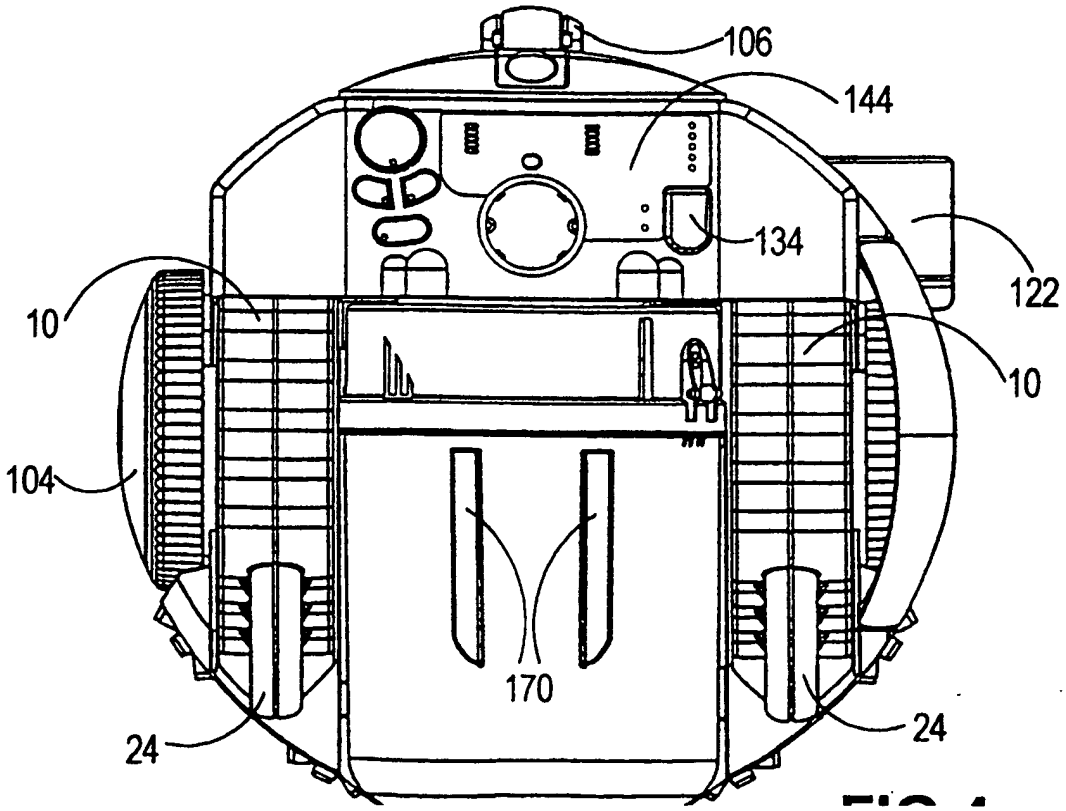
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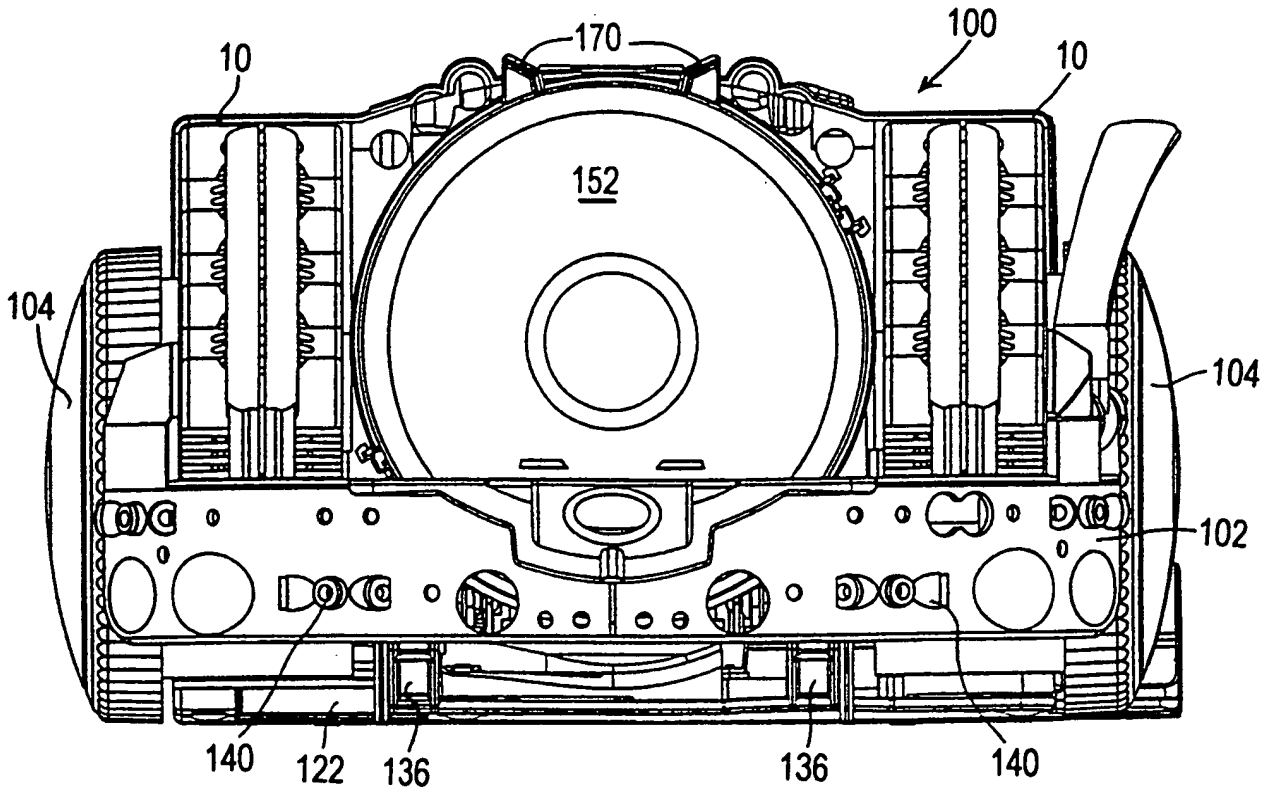
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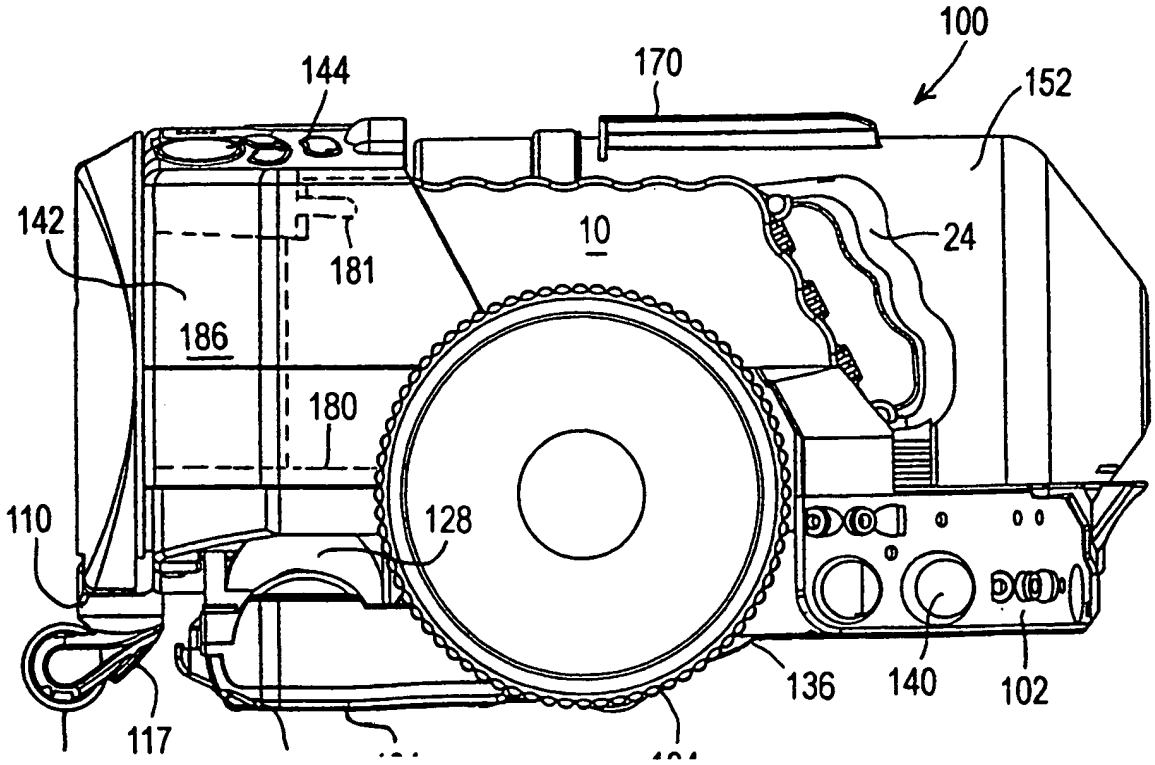
FIG.5.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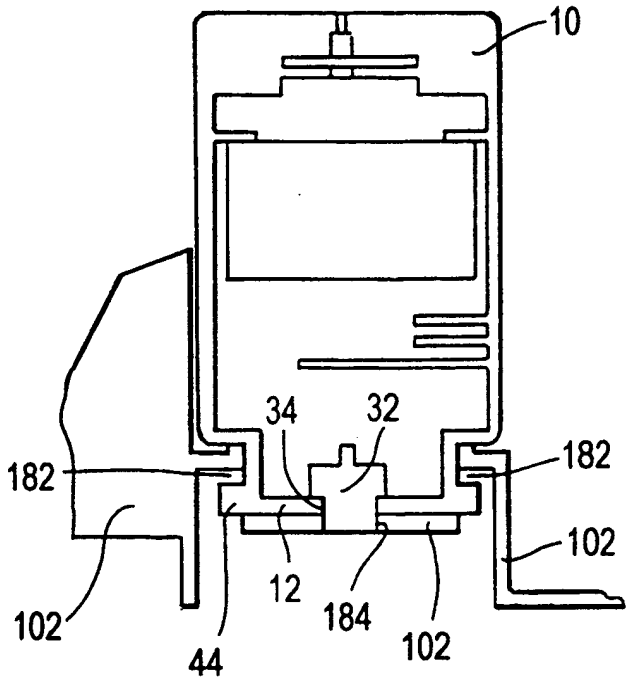
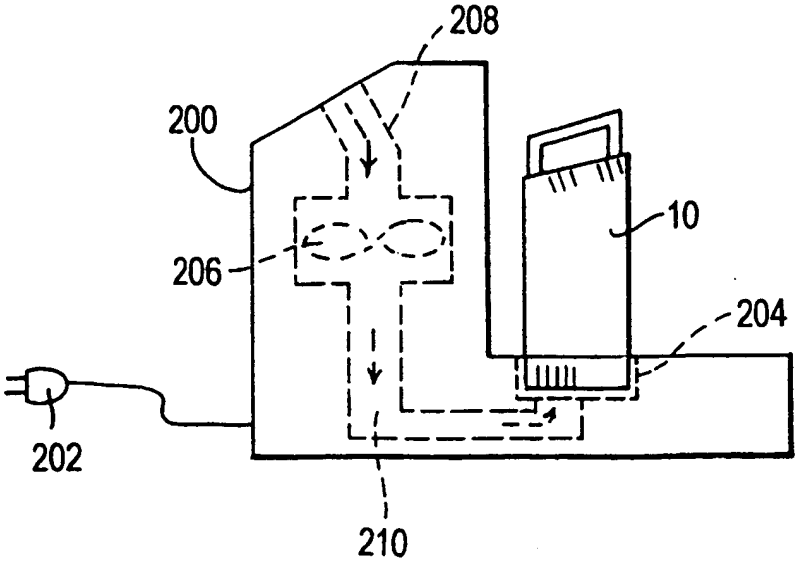


FIG 7



INTERNATIONAL SEARCH REPORT

Int ional Application No
PCT/GB 99/04075

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01M2/10 A47L9/28

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A47L H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 735 361 A (FORREST KENNETH R., LOS ALTOS HILLS, US) 7 April 1998 (1998-04-07) column 4, line 21 - line 65 figures 1,2	1,2,12
A		5,6,10, 11,15
X	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 08, 29 August 1997 (1997-08-29) & JP 09 095290 A (YAMAHA MOTOR CO LTD), 8 April 1997 (1997-04-08) abstract	1,2,6
A		5,11,15

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 February 2000	28/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk	

INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/GB 99/04075

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Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A47L H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

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A		5,6,10, 11,15
X	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 08, 29 August 1997 (1997-08-29) & JP 09 095290 A (YAMAHA MOTOR CO LTD), 8 April 1997 (1997-04-08) abstract	1,2,6
A		5,11,15

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Date of the actual completion of the international search	Date of mailing of the international search report
18 February 2000	28/02/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk	

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/GB 99/04075

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 635 236 A (BOESI ANNA MARIA, BERGAMO, IT) 25 January 1995 (1995-01-25) cited in the application column 1, line 20 - line 29 column 3, line 38 - line 53 claim 19 figure 2	1-7,12, 13,15
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INTERNATIONAL SEARCH REPORT

information on patent family members

Inter nal Application No
PCT/GB 99/04075

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